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ABSTRACT

This report describes four experiments concerned with the effects of lecturer's degree of eye contact upon his teaching effectiveness, determined by the degree of audience retention of his message and by the audience's rating of the lecturer. In the first experiment, a male lecturer addressed small groups of female students in a laboratory setting. A 2 x 4 factorial design was employed with four levels of the lecturer's gaze at the eyes of the students (gaze, preferred gaze, excluded gaze, and no gaze). The students evaluated the lecturer and lecture and took a short test on content. Results showed that the lecturer's gaze had an effect on audience retention and on their perception of the lecturer. Experiment 2 used two levels of gaze and two levels of movement, with methodology and dependent variables similar to the first experiment but with large groups of male students in a classroom setting. No significant differences were found in the results. Experiment 3 investigated the effects of a videotaped lecturer's gaze and most subjects, regardless of experimental condition, indicated a positive change in attitude. Experiment 4 used similar procedure to the first experiment but with more subtle manipulations and greater control of the lecturer's gaze. No significant results were found. Future research should involve experimentation in actual classrooms to explore the nonverbal behavior of effective and ineffective teachers. (MBM)

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NONVERBAL BEHAVIOR AND TEACHING EFFECTIVENESS

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Summary

This report contains a description of four experiments concerned with the effects of a lecturer's degree of search for eye contact upon his teaching effectiveness. His effectiveness is determined by the degree of audience retention of his message and by the audience's rating of the lecturer.

In the first experiment, a male lecturer addressed small groups of female students in a laboratory setting. A 2 x 4 factorial design was employed with two classroom settings (Lecture and Seminar) and four levels of the lecturer's gaze at the eyes of the students (Gaze, Preferred Gaze, Excluded Gaze, and No Gaze). After hearing a lecture on a German military plan for World War I, the students evaluated the lecturer and lecture, then took a short test on the lecture content. Students in the Gaze condition scored more highly on the quiz than did students in the other conditions. Students in the No Gaze condition rated the lecturer as less relaxed and less structured. Thus, the lecturer's gaze had an effect upon both audience retention and the audience's perception of the lecturer.

Experiment 2 employed a 2 x 2 factorial design with two levels of the lecturer's gaze (Gaze and No Gaze) and two levels of the lecturer's movement (Movement and No Movement). The methodology and dependent variables of this experiment were similar to those of the first. However, the lecturer addressed large groups of male students in a natural classroom setting. No significant differences in quiz scores or in evaluation of the lecturer were found. One explanation of the lack of results could be that the higher degree of interest in the lecture content by the male subjects may have overcome any inattentiveness produced by the lecturer's behavior.

Experiment 3 investigated the effects of a videotaped lecturer's gaze direction upon his perceived and actual persuasiveness. Student attitudes toward Mexican people were measured before and after viewing a videotaped lecture favorable toward Mexicans. Four tapes, each differing in the lecturer's frequency of looking

directly into the camera, were used (Constant Gaze, Frequent Glances, Infrequent Glances, No Gaze). Two control conditions (Audio Only and Essay) were also set up. Most subjects, regardless of experimental condition, indicated a positive change in attitude. The lecturer was evaluated most favorably in the Essay condition, less favorably in the Audio condition, and least favorably in the Videotaped conditions. Results are attributed to a "ceiling effect" of the message, demand characteristics of the experiment, and the negative impression generated by the lecturer.

Experiment 4 made use of a similar procedure and dependent variables as the first experiment. However more subtle manipulations and greater control of the lecturer's gaze were desired, so the lecturer was recorded on videotape. A 2 x 2 factorial design was employed with two levels of the lecturer's gaze duration (Short, Long) and two levels of the lecturer's gaze frequency (Infrequent, Frequent). Each of the four videotapes was viewed by 14 female undergraduates. No significant effects were found for quiz scores or for student evaluation of the lecturer.

Next steps in this line of research involve experimentation in actual classrooms. The nonverbal behavior of teachers who are seen as effective or ineffective by their students will be explored. The nonverbal behavior of members of the audience is also worthy of investigation. Not only can their behavior serve as an indicator of their attention level, but it can also affect the lecturer's behavior.

Introduction

No systematic exploration of the effects of certain nonverbal behaviors of a teacher on his teaching effectiveness has yet been attempted. The initiation of such a project is the subject of this report. Past researchers in the area of teacher effectiveness have generally employed descriptive or correlational investigatory techniques, leaving important variables uncontrolled (Barr, 1961). The present project employs the laboratory method and is designed to control, so far as possible, the effects of those variables other than the ones under investigation.

Certain nonverbal behaviors appear important in communicating attitude and thus may contribute to the persuasiveness of the behaver. In an investigation of gestural behavior, Rosenfeld (1966) secretly instructed one member of a pair either to seek or to avoid the approval of the other member. Persons seeking approval made significantly more total gestures, more positive head nods (males only), less negative head nods, and more arm, hand, or finger movements (females only). In the approval-avoiding condition, approval from the naive member was positively correlated with positive head nods and negatively correlated with self-manipulative gestures. Matarazzo, Wiens, and Saslow (1965) reported that positive head nods communicated a more positive attitude.

The observation of the posture of another's body is sometimes an aid in sensing the other's immediate mood or attitude. James (1932) had persons observe photographs of a man assuming 347 different postures. The persons were able to reliably name the attitudes expressed by the photos. More recently, Mehrabian (1968 a,b) has investigated the transmission and reception of attitudes via body posture. He found that forward leans of the body indicated a more positive attitude. Males displayed intense dislike for other males through a tense, direct confrontation, but for females through physical relaxation. Females appeared to display intense dislike for males or females through a high degree of relaxation and a turning away from the disliked one.

The initial nonverbal variable to be manipulated in this project is eye contact. Existing research indicate that this variable may prove important in determining teacher effectiveness. The degree of search for eye contact has been shown to reflect the actual attitudes and affect the perceived attitudes of the looker. A greater degree of eye contact appears to indicate a more positive attitude between the two lookers (Exline, Gray, and Schuette, 1965; Breed, 1971). Similarly, a greater amount of eye contact is interpreted by the person gazed upon as indicative of the positive attitude of the looker (Stass and Willis, 1967; Wiener and Mehrabian, unpublished). Exline and Eldridge (1967) reported that a speaker who made eye contact while speaking was judged as more sincere than a speaker who did not look.

Eye contact also appears to be associated with persuasiveness. Mehrabian and Williams (1969) asked persons to attempt to persuade another of certain information. A greater amount of eye contact was associated with increasing degrees of intended persuasiveness. Also, eye contact was positively correlated with perceived persuasiveness.

In the present project, the first experiment investigated the effects of a lecturer's degree of search for eye contact upon his teaching effectiveness. His effectiveness was determined by the degree of audience retention of his message and by the audience's rating of the lecturer. It was expected that persons who were looked directly in the eyes by the lecturer would retain more of the lecture information and would rate the lecturer as more effective than would persons at whom the lecturer did not look. In this experiment, the lecturer addressed small groups of female students in a laboratory setting.

The second experiment investigated the effects of a lecturer's gaze direction and degree of physical movement upon his teaching effectiveness. The methodology and dependent variables of this experiment were similar to those of the first. However, the lecturer addressed large groups of male students in a "natural" classroom setting.

A third and a fourth experiment were concerned with the effects of a videotaped lecturer's nonverbal behavior upon his audience. Videotaped lectures are increasingly common in our school systems, but little systematic information has been gathered as to how to increase the effectiveness of these lectures. The third study was designed as a beginning in a search for such information. The effects of a videotaped lecturer's gaze direction upon his perceived and actual persuasiveness were investigated. Student attitudes toward Mexican people were measured before and after viewing a videotaped lecture favorable toward Mexicans. Four tapes, each differing in the lecturer's frequency of looking directly into the camera, were used.

The fourth experiment investigated the effects of a videotaped lecturer's pattern of gaze upon his teaching effectiveness. Dependent variables included student retention of the lecture content and evaluation of the lecturer.

The four studies in this project provide the beginning of a comprehensive research program designed to contribute to the development of the classroom as an exciting place of learning. Ultimate research objectives are to determine what combinations of specific nonverbal categories (gaze direction, body posture, gestures, interpersonal distance) bring about maximum teacher effectiveness.

Experiment 1: The Effect of a Lecturer's Gaze Direction Upon Teaching Effectiveness

This study is the first step in a project designed to systematically explore the effects of the nonverbal behavior of a teacher upon his teaching effectiveness. Certain nonverbal behaviors, in particular eye contact (Exline, 1963), gestures (Rosenfeld, 1966), and body posture (Mehrabian, 1968a, 1968b), appear important in communicating attitude and thus may contribute to the persuasiveness of the behaver. In the present study, the effects of eye contact upon teaching effectiveness are investigated.

Existing research indicates that the degree of search for eye contact has been shown to reflect the actual attitudes and to affect the perceived attitudes of the looker. A greater degree of eye contact appears to indicate a more positive attitude between the two lookers (Exline, Gray, and Schuette, 1965; Breed, 1971). Similarly, a greater amount of eye contact is interpreted by the person gazed upon as indicative of the positive attitude of the looker (Stass and Willis, 1967). Exline and Eldridge (1967) reported that a speaker who made eye contact while speaking was judged as more sincere than a speaker who did not look.

Eye contact also appears to be associated with persuasiveness. Mehrabian and Williams (1969) asked persons to attempt to persuade another of certain information. A greater amount of eye contact was associated with increasing degrees of intended persuasiveness. Also, eye contact was positively correlated with perceived persuasiveness.

In the campus environment, two interpretations of teacher effectiveness appear to be in vogue. Faculty members are generally concerned with how much the student learns or retains, while students put more emphasis on such teacher characteristics as vibrancy, clarity, and sincerity. The present study incorporates both interpretations. Effectiveness is operationally defined by the degree of audience retention of the teacher's message and by the audience's rating of the teacher on such characteristics as persuasiveness and clarity.

General expectations are that eye contact will enhance teaching effectiveness. In particular, persons who are looked directly in the eyes by a lecturer will retain more of the lecture information and will rate the lecture as more effective than will persons at whom the lecturer does not look.

Method

Subjects

Ninety-six female students enrolled in the undergraduate program at the University of South Dakota participated in the experiment. The students were volunteers from an introductory psychology course and from local sororities.

Design

A 2 x 4 factorial design was employed with two classroom settings (Lecture and Seminar) and four levels of the lecturer's gaze at the eyes of the subjects (Gaze, Preferred Gaze, Excluded Gaze, and No Gaze). Dependent variables included the degree of subjects' retention of the lecturer's message (quiz scores) and the subjects' perception of the lecturer (semantic differential scores).

Procedure

A miniature classroom scene was set up in the laboratory for increased control. In the Lecture condition, 48 students (four at a time, seated side-by-side) were addressed by a male lecturer, who stood behind a lectern. The distance between the lecturer and students was approximately seven feet. In the Seminar condition, 48 students (four at a time) sat with the lecturer around a circular table, 6 feet in diameter. The students sat with their backs to a one-way mirror.

The female experimenter met each group of four subjects, ushered them into the experimental room, seated them, and gave them the following instructions:

> As you already know, this study is concerned with teacher effectiveness. A lecturer is

going to come in and deliver a brief talk for 10 minutes. Please pay attention to him during his talk. I want you to be thinking about helpful comments or criticisms you could give that would help make him a better teacher.

After he has finished, I will come back with questionnaires to fill out about the lecture, including your comments. It is rather important that you pay attention the whole time that he lectures. It doesn't take long. Any questions?

Upon completion of these initial instructions, the experimenter left the room and the lecturer entered. The lecturer introduced himself by name and began his lecture on the Schlieffen plan, the German military plan for World War I. The topic was deliberately chosen as one with which most students would not be familiar. A copy of the lecture is presented in Appendix A-1.

During some lecture sessions, the lecturer looked occasionally into the eyes of two of the four students (Preferred Gaze), but never looked into the eyes of the other two students (Excluded Gaze). During other sessions, the lecturer either looked occasionally (Gaze) or never looked (No Gaze) into the eyes of all four of the assembled students. For all conditions, the lecturer was careful to make no hand and arm gestures or gross body movements.

After the lecture, the lecturer left the room and the experimenter re-entered with a questionnaire (Appendix A-2) for the subjects to complete. The subjects were asked to describe the lecturer on 36 semantic differential scales: seven-point scales anchored at each end by opposing constructs, such as good-bad, persuasive-unpersuasive, passive-active. Subjects also described the lecture on four scales: interesting-boring, valuable-worthless, false-true, profound-shallow.

The questionnaire also gave the subjects the opportunity to give their opinion as to how the speaker's performance could be improved. The students checked either "yes" or "no" as to whether the speaker should

speak louder, more distinctly, slower, or faster and whether he should make more or fewer gestures, improve his personal appearance, look in eyes more or less, or simplify the lecture. Finally, the subjects indicated how much they would like to have the lecturer as a teacher in a real classroom situation.

After completing the questionnaire, the subjects were given a short test on the content of the lecturer's talk. The quiz consisted of fifteen questions calling for specific answers and ended with a question intended to assess the subject's familiarity with the lecture content previous to the experiment (See Appendix A-3).

The students were debriefed concerning all aspects of the experiment except for the Gaze manipulation, thanked for their participation, and dismissed.

Results

Manipulation check

For each of the 24 lectures, the lecturer's behavior was recorded on video-tape. A camera equipped with a telephoto lens was concealed behind a one-way mirror, which was directly behind the subjects and directly facing the lecturer. Two judges used an Esterline-Angus recorder (Exline, 1963) to record the frequency and duration of the lecturer's gaze at each subject's eyes. Inter-judge reliability ranged from .72 to .97 with a mean reliability of .90.

The frequency and duration of the lecturer's gaze at each subject is presented in Appendix A-4. The mean frequency and the mean number of minutes of the lecturer's gaze according to experimental conditions are presented in Table 1. The lecturer looked significantly more frequently ($F = 68.73$, $p < .001$) and for a longer duration ($F = 131.93$, $p < .001$) at the subjects in the Preferred Gaze condition than at the subjects in the Gaze condition. He also looked longer at the subjects in the Seminar condition than at the subjects in the Lecture condition ($F = 7.98$, $p < .01$).

Table 1

Mean Frequency and Mean Total Duration (Minutes) of Lecturer's Gaze

	Gaze		Preferred Gaze	
	Lecture	Seminar	Lecture	Seminar
Mean Frequency	45.91	48.58	78.58	80.08
Mean total duration (minutes)	2.47	3.36	5.43	5.89

Thus, certain situational factors overrode the lecturer's attempts to keep his gaze constant across experimental conditions. He looked more when his task was to look at two people in an audience of four than when he had to look at all four. He also looked longer when seated around a table with the subjects than when standing behind a lectern.

Quiz scores

In order to eliminate the possibility that subjects across the experimental conditions, even though randomly assigned to groups, differed in previous familiarity with the lecture contents, an analysis of previous familiarity was conducted. The means of subjects' responses to the question "How familiar were you with the content of the lecture before you heard it today?" are presented in Table 2. Unfortunately, the question was asked after the administration of the quiz. Answers might have been biased by quiz performance. Subjects who performed poorly on the quiz may have been tempted to claim less previous familiarity with the lecture content. However, as shown by the analysis of variance of familiarity scores in Table 3, no significant effect due to the treatment conditions was found.

The lecturer, blind as to which quiz belonged to which experimental condition, scored all 96 quizzes for the correctness of their answers. A maximum of one point could be obtained for each of the 15 questions. Scores ranged from 0 to 12.5, with a mean of 4.67. Mean quiz scores are presented in Table 4 and individual scores in Appendix A-5.

Analysis of variance of the quiz scores (Table 5) revealed a significant effect due to the Gaze manipulation ($F = 3.30$, $p < .05$). Performance of a post-hoc test, the Tukey "a" (Winer, 1962), yielded a critical difference of 2.50. Thus, the only "real" difference in quiz scores is between the scores in the Gaze condition and the scores in the Excluded Gaze condition.

Table 2

Mean Previous Familiarity with Lecture Content

	Gaze	Preferred Gaze	Excluded Gaze	No Gaze
Lecture	2.00	1.55	2.50	1.25
Seminar	2.25	2.33	1.58	2.00
Total	2.13	1.96	2.04	1.63

Table 3

Analysis of Variance for Previous Familiarity

Source	df	MS	F	p
Lecture Style (A)	1	1.04	.60	NS
Gaze (B)	3	1.15	.67	NS
A X B	3	3.17	2.15	NS
Within cell	88	1.73		

Table 4

Mean Quiz Scores

	Gaze	Preferred Gaze	Excluded Gaze	No Gaze
Lecture	6.33	2.88	4.21	3.88
Seminar	6.63	5.63	3.50	4.33
Total	6.48	4.25	3.85	4.10

Table 5

Analysis of Variance for Quiz Scores

Source	df	MS	F	p
Lecture Style (A)	1	11.69	1.09	NS
Gaze (B)	3	35.48	3.30	<.05
A X B	3	12.82	1.19	NS
Within cell	88	10.78		

Evaluation of lecturer

The 36 semantic differential scale ratings of the lecturer for all 96 subjects were factor analyzed by the principal-axis method. Rotation using the varimax criterion showed the first three factors to account for 44% of the variance. Table 6 presents the varimax factor loadings and communality for each of the 36 scales plus the variance accounted for by each of the three factors.

The first factor, which accounted for roughly 20% of the total variance, appears related to the subjects' perception of the lecturer's vibrancy and persuasiveness. Ten scales contributed highly to the makeup of this factor: boring-exciting, unpersuasive-persuasive, ineffective-effective, unresponsive-responsive, stale-fresh, still-vibrant, static-dynamic, passive-active, inattentive-attentive, and remote-intimate. (The scales are presented here and in the other factors described below in the descending order of their contribution.)

The second factor, accounting for 14% of the variance, appears concerned with the lecturer's degree of structure. Scales loading highly on this factor are illogical-logical, chaotic-ordered, dishonest-honest, subtle-obvious, and repetitive-varied.

Three scales (relaxed-tense, calm-agitated, and peaceful-ferocious) loaded highly on Factor Three, which accounted for about 9% of the variance.

The scales listed above as contributing to a factor were summed for that factor to produce one over-all score for each factor for each subject. The means of these three Factor Scores (Persuasive, Structured, Relaxed) are presented in Table 7 for each experimental condition. The higher the score, the higher the subjects rated the lecturer on that particular factor.

Analyses of variance for the three Factor scores (Table 8) revealed a significant effect due to the Gaze manipulation for the Structured scores ($F = 4.45$, $p < .01$) and for the Relaxed scores ($F = 3.74$, $p < .05$). No significant effects were found for the Persuasive scores.

Table 6

Varimax Factor Loadings and Communality for
Semantic Differential Scales

Scale	Factor Loadings I	II	III	Communality
1. Passive-Active	.6095	-.2196	.0352	.421
2. Fair-Unfair	.1138	-.4194	-.1799	.221
3. Attentive-Inattentive	.5960	-.3107	-.1812	.485
4. Good-Bad	.6710	-.0845	-.4694	.678
5. Happy-Sad	.3689	-.3015	.0407	.229
6. Fast-Slow	.1012	-.3505	.1353	.151
7. Valuable-Worthless	.4660	-.3658	-.1917	.388
8. Honest-Dishonest	.0331	-.5951	-.2462	.416
9. Intimate-Remote	.5229	-.0948	.0276	.283
10. Confident-Unsure	.3607	-.2536	-.5538	.501
11. Profound-Superficial	.2322	-.3523	-.0503	.181
12. Calm-Agitated	.0537	-.0334	.7059	.502
13. Peaceful-Ferocious	.2087	-.0919	.5768	.385
14. Relaxed-Tense	.0341	-.1539	.7227	.547
15. Clear-Hazey	.5418	-.1837	-.3899	.479
16. Fresh-Stale	.7433	-.1145	-.2659	.636
17. Delicate-Rugged	.1582	-.3099	-.0969	.130
18. Logical-Illogical	.2452	-.7348	-.2161	.647
19. Dynamic-Static	.6101	-.2295	-.0242	.425
20. Obvious-Subtle	.2124	-.5824	-.1299	.401

Table 6 Continued

Varimax Factor Loadings and Communality for
Semantic Differential Scales

Scale	Factor Loadings I	II	III	Communality
21. Ordered-Chaotic	-.0388	-.7146	-.3634	.644
22. Competent-Incompetent	.4005	-.3932	-.4354	.505
23. Simple-Complex	-.1890	-.4621	-.1150	.262
24. Persuasive-Unpersuasive	.7588	-.2268	-.0068	.627
25. Varied-Repetitive	.2870	-.5067	.0813	.346
26. Rational-Emotional	.0666	-.2199	.0546	.558
27. Still-Vibrant	.7165	-.0845	.1222	.536
28. Vague-Precise	.3684	-.6101	-.1977	.547
29. Sincere-Insincere	.4375	-.5381	-.2035	.522
30. Loose-Controlled	.0587	-.3515	-.4316	.313
31. Unconvincing-Convincing	.6469	-.4415	-.1804	.646
32. Boring-Exciting	.7742	-.0971	-.2124	.654
33. Unfriendly-Friendly	.2453	-.4412	-.2184	.303
34. Unaware-Aware	.3631	-.3968	-.4189	.465
35. Unresponsive-Responsive	.7384	-.2296	-.1562	.622
36. Ineffective-Effective	.7427	-.2561	-.3090	.713
% Variance Accounted for	20.61	13.99	9.47	

Table 7

Mean Factor Scores

	Gaze	Preferred Gaze	Excluded Gaze	No Gaze
Persuasive				
Lecture	4.23	4.14	4.39	4.18
Seminar	4.32	4.51	4.69	4.34
Total	4.28	4.33	4.54	4.26
Structured				
Lecture	3.98	4.07	4.27	3.48
Seminar	3.98	4.68	4.70	3.63
Total	3.98	4.38	4.48	3.56
Relaxed				
Lecture	4.75	4.36	4.53	3.83
Seminar	4.83	4.64	4.61	3.78
Total	4.79	4.50	4.57	3.81

Table 8

Analysis of Variance for Factor Scores

Source	df	Persuasive		Structured		Relaxed	
		MS	F	MS	F	MS	F
Lecture Style (A)	1	126.00	2.75	54.00	2.27	2.04	.20
Gaze (B)	3	41.10	.90	105.92	4.45**	39.19	3.74*
A X B	3	9.83	.22	11.53	.49	1.01	.10
Within cell	88	45.81		23.79		10.47	

Note * $p<.05$.

** $p<.01$.

The Tukey (a) procedure was used to test for significant differences ($p < .05$) between pairs of means. For the Structured scores, a significant difference was found between the No Gaze condition and the Preferred and Excluded Gaze conditions. Subjects in the No Gaze condition rated the lecturer as less structured ($M = 3.56$) than did the subjects in either the Preferred Gaze ($M = 4.38$) or the Excluded Gaze ($M = 4.38$) condition. No significant differences were found between scores in the Gaze condition and scores in the other three conditions.

For the Relaxed scores, the only significant difference was between the No Gaze and the Gaze condition. Subjects in the No Gaze condition rated the lecturer as less relaxed ($M = 3.81$) than did the subjects in the Gaze condition ($M = 4.79$).

Subjects were also asked to rate, on a seven-point scale, how much they would like to have the lecturer as a teacher in a real classroom situation. Mean ratings are presented in Table 9. A higher score indicated greater preference. Table 10 presents an analysis of variance for Perference scores. No significant effects were found.

Rating of lecture

Subjects rated the lecture on four seven-point scales (Interesting-Boring, Valuable-Worthless, False-True, Profound-Shallow). An intercorrelation of the four scales showed them to be positively related. As shown in Table 11, the correlation coefficients ranged from .36 to .74. Therefore, the scales were combined and an analysis of variance (Table 12) performed on the resulting sum score. The mean sum scores are presented in Table 13. No significant differences were found.

Suggestions for improvement of lecturer's performance

Subjects were given the opportunity to suggest whether the lecturer's performance could be improved through speaking louder, speaking more distinctly, speaking slower, speaking, faster, making more gestures, making fewer gestures, improving his appearance, looking more, looking less, or by

Table 9

Mean Preference Scores

	Gaze	Preferred Gaze	Excluded Gaze	No Gaze
Lecture	3.08	2.75	3.33	2.67
Seminar	3.17	3.50	3.42	2.00
Total	3.13	3.13	3.38	2.34

Table 10

Analysis of Variance for Preference Scores

Source	df	MS	F	p
Lecture Style (A)	1	.09	.04	NS
Gaze (B)	3	4.93	1.87	NS
A X B	3	2.01	.76	NS
Within cell	88	2.64		

Table 11

Intercorrelation of Lecture-Rating Scales

	Valuable	True	Profound
Interesting	.74	.37	.36
Valuable		.45	.53
True			.45

Table 12

Analysis of Variance for Lecture-Rating Sum Score

Source	df	MS	F	p
Lecture Style (A)	1	4.17	.17	NS
Gaze (B)	3	43.35	1.77	NS
A X B	3	14.14	.58	NS
Within cell	88	24.46		
Total	95			

Table 13

Mean Lecture-Rating Scores

	Gaze	Preferred Gaze	Excluded Gaze	No Gaze
Lecture	5.08	4.73	4.50	4.75
Seminar	5.23	5.36	4.40	4.50
Total	5.16	5.04	4.45	4.63

simplifying the lecture. Subjects responded to each of these categories by checking either yes or no. The frequency of response for each suggested improvement are classified according to Gaze condition and Lecture condition in Appendix A-6.

Of the 48 stubjects who were not looked at, 41 suggested that the lecturer could improve his performance through looking more. Only 7 of the 48 subjects who were looked at approved of this suggestion. The difference in responses by these two groups of subjects is significant at the .001 level (Chi-squared = 48.16).

Only eight of the 24 subjects in the Gaze condition thought the lecture should be simplified, while 19, 18, and 15 of the subjects in the No, Preferred, and Excluded conditions, respectively, were in favor of simplification. The difference in responses by the subjects in the Gaze and No Gaze conditions is significant at the .005 level (Chi-squared = 10.24).

Discussion

The general hypothesis of this study was that the direction of gaze by a lecturer would make a difference in his audience's retention of the lecture content and in their perception of him. In particular, greater retention and a more positive perception were predicted for those who were looked directly in the eyes by the lecturer (those in the Gaze and Preferred Gaze conditions). This prediction received partial support. The results concerning the audience's retention and the results concerning their perception of the lecturer will be discussed separately.

Rather than being rigidly bound by the post-hoc statistics (the Tukey "a", a rather conservative test), which tell us that the Gaze quiz mean (6.48) differs only from the Excluded Gaze quiz mean (3.85), let us for purposes of discussion venture beyond the .05 level and speak of a difference between the Gaze quiz mean and the Preferred Gaze (4.25) and No Gaze (4.10) quiz means. Such a venture may produce provocative new hypotheses.

The concept of attentiveness provides us with an adequate explanation of the results. The students who scored higher on the quiz did so because they were paying more attention to the lecture. They paid more attention possibly because the lecturer, by looking occasionally into their eyes, showed that he was interested in the audience and that he was monitoring their reactions. His interest was returned. Conversely, the non-looking lecturer's apparent disinterest, either in the lecture (No Gaze) or in the student (Excluded Gaze), may have been reciprocated by those students.

The inattentiveness of the students in the Preferred Gaze condition may have been due to too much attention being paid to them. After all, the male lecturer not only looked at them to the exclusion of others but, contrary to plan, looked about twice as much at them as at the students in the Gaze condition. Thus, the lecturer's gaze could have resulted in self-consciousness or minor embarrassment and diverted the students' attention from the lecture.

The attentiveness explanation receives further support from the students' suggestions for improvement of the lecturer's performance. An attentive student may perceive a lecture as less complex than a non-attentive student. Fewer students in the Gaze condition than in the other conditions thought that the lecture should be simplified.

Before consideration of the students' perception of the lecturer, one point should be made. Even the most negative mean evaluation of the lecturer (3.48) was not very negative considering the subjects' potential range of responses on a seven-point scale. The "negative" response comes close to a rating of 4--a rating of "neither favorable nor unfavorable." To speak of a relatively negative or positive response is more accurate than to speak in absolutes.

The data reveal that the lecturer was evaluated most negatively in the No Gaze condition. When the lecturer looked at no one in the audience, he was viewed as less structured (more illogical, chaotic, dishonest, subtle, and repetitive) and less relaxed (more tense, agitated, ferocious). As long as the lecturer looked at someone in the audience, he was viewed even by those individuals who were not the objects of his gaze in a more favorable light.

It appears that not only can a lecturer's gaze have an effect upon his audience's retention of the lecture content and upon their perception of him, but the audience expects a certain amount of eye contact with the lecturer. Eighty-five percent of the subjects who were not looked at, as opposed to 15% of the subjects who were, suggested that the lecturer could improve his performance by looking more.

Generalization from a 5-minute lecture delivered in a laboratory to an audience of four female students at a time to the complexities of a college classroom can be hazardous. However, it appears that a lecturer's looking behavior can influence his effectiveness as a teacher.

Experiment 2: The Effects of Gaze Direction and Motility Upon Teaching Effectiveness

The methodology and dependent variables of this experiment are similar to those of the first. The same male lecturer gave the same lecture to groups of students. However, the lecturer addressed large groups of male students in a "natural" classroom setting rather than small groups of female students in a laboratory setting. The lecturer's gaze direction and degree of physical movement were varied across experimental conditions.

Method

Subjects

Out of 80 volunteers from an introductory psychology course at the University of South Dakota, 58 male students participated in the experiment.

Design

A 2 x 2 factorial design was employed with two levels of the lecturer's gaze (Gaze and No Gaze) and two levels of the lecturer's movement (Movement and No Movement). Original plans were for 20 students to participate for each of the four experimental conditions. Since some students did not make their scheduled appearance, it was necessary to use an unweighted-means analysis (Winer, 1962, p.241) of the data.

Dependent variables included the degree of subjects' retention of the lecturer's message (quiz scores) and the subjects' perception of the lecturer (semantic differential scores).

Procedure

A male graduate student in psychology lectured four groups of undergraduate males on the Schlieffen plan, a German military plan for World War I (Appendix A-1). For the first and second groups, the lecturer remained behind the lectern for the duration of the lecture. He looked at the eyes of individuals in the audience for one group (Gaze, No Movement) and never looked at the

eyes of the audience for the other groups (No Gaze, No Movement).

For the third and fourth groups, the lecturer moved from behind his lectern several paces to his right or his left when making certain points. He did not look at the eyes of the audience for one group (No Gaze, Movement), but did look for the other group (Gaze, Movement).

A female experimenter introduced the lecturer to the group with the same instructions as in Experiment 1. Upon completion of these initial instructions, the experimenter left the room and the lecturer entered. The lecturer introduced himself and began his lecture.

After the lecture, the subjects were asked to complete a questionnaire (Appendix A-2) asking for their evaluation of the lecture and lecturer. Subjects were then given a 15 item test on the lecture content (Appendix A-3).

Results

Quiz scores

Individual and mean quiz scores for each experimental condition are presented in Table 14. An unweighted means analysis of the scores (Winer, 1962) revealed no significant difference in the test scores as a function of the treatment conditions. Neither the lecturer's gaze direction nor his degree of physical movement had a significant effect upon the subjects' test scores.

Evaluation of the lecturer

Subjects' responses on the semantic differential scales to the lecturer were analyzed in the same manner described in the first experiment. Scales were combined to produce three sum scores (Persuasive, Structured, Relaxed).

These sum scores were used as dependent variables in a 2 x 2 (Gaze, No Gaze, Movement, No Movement) analysis

Table 14

Individual and Mean Quiz Scores

	Movement		No Movement	
Subject	Gaze	No Gaze	Gaze	No Gaze
1	4.0	11.0	6.5	12.5
2	8.0	11.0	8.5	9.0
3	4.5	11.5	8.0	13.0
4	2.0	10.5	6.0	11.5
5	4.0	8.0	10.0	11.0
6	11.	9.0	12.5	9.0
7	10.5	8.0	4.5	2.5
8	4.5	4.5	12.0	2.5
9	9.5	4.5	8.0	1.5
10	9.5	11.5	2.0	7.0
11	5.5	5.0	9.5	13.0
12	7.0	8.5	2.5	7.0
13		14.5	8.5	11.5
14		1.0	11.0	10.0
15			4.5	6.0
16			11.5	
17			3.0	
Mean	6.71	8.46	7.56	8.47
n	12	14	17	15

of variance. No significant effects of the independent variables upon the sum scores were found.

Evaluation of the lecture

The four seven-point scales on which the subjects rated the lecture (Interesting-Boring, Valuable-Worthless, False-True, Profound-Shallow) were summed for each subject and an analysis of variance performed on the sum scores. No significant differences were found.

Suggestions for improvement of lecturer's performance

As in the first experiment, the subjects who were not looked at more frequently suggested (27 out of a total of 30 subjects) that the lecturer could improve his performance by looking more than did the subjects who were looked at (14 out of 29).

Also once again, the subjects who were looked at felt less need for simplification of the lecture than did the non-gazed-upon subjects. Seventeen out of 30 subjects in the No Gaze conditions were for simplification, while only 7 out of the 29 subjects in the Gaze condition were in favor of this suggestion.

Discussion

Regardless of the lecturer's degree of gaze and amount of movement, the audience perceived the lecturer and his lecture in a mildly favorable light. The lecturer's manipulated behavior also had no significant effect upon the audience's short-term retention of the lecture material.

Once again, the concept of attentiveness may provide us with an explanation of the results. Several of the female students in the first experiment remarked that the lecture content was of little interest to females. Thus, their attentiveness and consequent retention of the lecture material appeared to be a function of the lecturer's behavior rather than interest in the lecture content.

The male students in the second experiment may have had a greater interest in a lecture on war plans of the Germans than did the females in the first experiment.

Some evidence for this interest comes from the male students' generally higher test scores (male mean= 7.80, Female mean = 4.67). Heightened interest in the lecture content may have overcome any inattentiveness produced by the lecturer's behavior.

One implication of this explanation is that an inherently interesting topic might be "safely" handled by a nonverbally dull lecturer. An audience might pay attention and learn in spite of the lecturer's behavior. Conversely, a lecturer's nonverbal behavior should be quite important when the topic itself is of little interest to the audience.

The validity of this explanation must rest, of course, upon the results of future experimentation. Other obvious differences between Experiments 1 and 2 (setting, sex of subjects, physical distance from lecturer to student, slightly different independent variables) could account for the differences in results. None seem as theoretically exciting, however, as the hypothesis of an interaction between the lecturer's nonverbal behavior and the interest value of the lecture.

Experiment 3: The Effects of a Videotaped Lecturer's Gaze Direction Upon His Perceived and Actual Persuasiveness

Videotaped or filmed lectures are now included not only within the domain of educational television stations, but are becoming increasingly common in our school systems, especially at the college and university level. Little systematic information has been gathered as to how to increase the effectiveness of these lectures. The present study is designed as a beginning in a search for such information. It is expected that the degree to which a lecturer looks directly into the camera will affect his persuasiveness.

Method

Subjects

Seventy-seven male and 54 female students enrolled in the undergraduate program at the University of South Dakota participated in the experiment.

Design

A two by six-factor design was employed. The six treatment conditions included four levels of the lecturer's frequency of looking directly into the video camera (Constant Gaze, Frequent Glances, Infrequent Glances, and No Gaze) and two control conditions (Audio Only and Essay). Effects of subject sex were also analyzed.

Dependent variables included the degree to which the viewer's attitude was affected by the experimental conditions and the viewer's evaluation of the lecturer.

Procedure

A pre-test, experimental condition, post-test paradigm was employed. Four to seven weeks after the subjects completed an initial measure of their attitude toward the Mexican people, they were assigned to one of the six experimental conditions. After seeing, hearing or reading a message highly favorable in content toward Mexicans, the subjects completed a second measure of their attitudes.

Pre-test. The attitude scale was a Thurstone type scale developed by Grice (Shaw and Wright, 1967, p. 410). Subjects were given a list of statements about Mexicans, such as "The world is better off by having these people in it.", and asked to indicate their agreement or disagreement with each statement. The scales were administered during class to a class of introductory psychology students and a class of introductory social psychology students. The person who administered the scales was a different person than the person in charge of the later experimental manipulation.

Experimental conditions. A male graduate student in psychology memorized a message which was highly favorable in content concerning the Mexican people. Four videotapes of the lecturer were made, each of which differed in the frequency with which he looked directly into the camera.

The tapes for the No Gaze and the Constant Gaze conditions were rather simple to make. For the No Gaze condition, the lecturer delivered his message while never looking directly into the camera. In the Constant Gaze condition, the lecturer gazed directly into the camera during his entire presentation.

Initial plans for the other conditions were for the lecturer to look 50% of the time for one condition and 25% of the time for the other. In experimenting with the frequency of looks and the duration of each look that should be used, it was decided that relatively short looks coming at the end of sentences or paragraphs appeared most natural (Kendon, 1967). Rather than have looks of varying duration, it was decided to use short looks (of about one second) and vary the number of times that the lecturer looked at the camera.

For the Infrequent Glances condition, the lecturer looked 26 times at the camera for a total of 25.4 seconds. For the Frequent Glances condition, the lecturer looked 52 times at the camera for a total of 66 seconds.

A maximum of three subjects of the same sex viewed the tape at one time. Two adjoining rooms were used, each with its own TV monitor, so that six subjects could participate at once. When, as sometimes happened, some students did not appear for their appointment, the tape was shown to the one or the two students who did appear.

The subjects in the Audio Only condition heard the audio portion of the video tape and never saw the lecturer. The subjects in the Essay condition read a transcript of the recorded message and neither saw nor heard the lecturer.

After the subjects had been seated before the TV monitors, the experimenter gave the following instructions:

> As you know, the use of videotaped or filmed lecturers in our school systems is increasing, especially at the college and university level. We have very little information as to how effective these lecturers are. We would like for you to help us in the search for such information.
>
> Before we begin, I would like to get some information from you concerning your past experience with the present feelings about videotaped lectures. Will you please fill out this questionnaire?

Each student was given a one page questionnaire asking for his opinions about videotaped lectures. After all students had completed the questionnaire, the experimenter instructed:

> Thank you. In a moment you will be shown (hear the sound track from) a video tape of a person delivering a lecture. After you have seen (heard) the tape, you will be asked to rate the lecturer on his effectiveness. You will also be asked to give your comments upon ways to improve the lecturer's performance and upon ways to improve the overall quality of the tape. Do you have any questions at this point?

(Students in the Essay condition were asked to read the transcript of a lecture which had been prepared by a certain person. They were told that they would be asked later to give their comments on ways to improve the lecture.)

Post-test. After the tape had played, the experimenter instructed:

> Okay. Will you now complete this booklet, please. The booklet is in several parts. Please read each set of instructions carefully. The instructions should be self-explanatory, but if you have any trouble, raise your hand and I will help you.

The booklet requested the subject to rate the lecturer and his lecture on seven-point semantic differential scales and to give his opinion as to how the lecturer's performance could be improved. The booklet also asked for the subject's personal opinion about the Mexican people. This opinion scale was the same scale the subject had completed several weeks previously, but typed in a slightly different form to hinder recognition.

Subjects were given an opportunity to make written comments concerning any aspect of the experiment, thanked, and dismissed.

Results

The twelve experimental conditions were not equal in the number of subjects participating. The showing of the videotape to groups of irregular size was partially responsible. The number of female subjects in the Audio and Essay conditions was especially low because of the eventual lack of female subjects who met our criteria (the completion of an attitude scale several weeks before the experiment and a willingness to participate). The unequal cell means were taken into account for all analyses performed.

Attitude Change

The difference between pre-test and post-test scores on the scale measuring attitudes toward Mexicans was used as an indicator of attitude change. Mean attitude change scores are presented in Table 15. Mean scores in each experimental condition indicate a positive change in attitude toward the Mexican people. An analysis of the variance of the attitude change scores revealed no significant main effects or interactions.

Evaluation of lecturer

The lecturer was rated by the subjects on six seven-point semantic differential scales (unpersuasive-persuasive, boring-exciting, insincere-sincere, simple-complex, remote-intimate, incompetent-competent). Since an intercorrelation analysis showed a score based on the sums of responses to the six scales to account for approximately 80% of the variance, this sum score was used as a dependent variable in the analysis of the lecturer evaluation data.

Mean sum scores for each of the twelve experimental conditions are presented in Table 16. The potential range of these scores is from 6 to 42, a higher score indicating a more favorable evaluation of the lecturer. An analysis of variance of the sum scores revealed only one significant effect--that due to treatment condition ($F = 7.33$, $df = 5, 124$, $p < .001$). Sex of the subject was not significant.

Table 15

Mean Attitude Change Scores

		Constant Gaze	Infrequent Glances	Frequent Glances	No Gaze	Audio	Essay
Male Subjects	$\bar{x}$	41.04	46.25	38.90	44.28	38.31	47.98
	n	12	14	13	15	12	11
Female Subjects	$\bar{x}$	47.26	32.94	58.44	55.08	27.02	36.53
	n	11	12	11	11	5	4
TOTAL	$\bar{x}$	44.01	40.11	47.85	48.85	34.99	44.93

Table 16

Mean Sum Scores (Rating of Lecturer)

		Constant Gaze	Infrequent Glances	Frequent Glances	No Gaze	Audio	Essay
Male Subjects	$\bar{x}$	16.92	14.79	18.54	16.20	20.50	24.46
	n	12	14	13	15	12	11
Female Subjects	$\bar{x}$	18.00	17.25	17.18	14.00	22.00	23.75
	n	11	12	11	11	5	4
TOTAL	$\bar{x}$	17.44	15.92	17.92	15.27	20.94	24.27

Each of the means in the Audio and in the Essay conditions were compared to the average of the four means in the Videotape conditions. Subjects in the Audio and in the Essay conditions evaluated the lecturer significantly more favorably than did the subjects in the four Videotape conditions ($F = 9.58$, 1,125, $p<.01$ and $F = 27.01$, 1,125, $p<.01$, respectively). Subjects in the Essay condition evaluated the writer of the lecture they read more favorabley than the Audio subjects avaluated the lecturer whom they heard ($F = 3.14$,1,125, $p<.10$).

Within the Videotape conditions, a test for differences between the Constant Gaze and No Gaze means revealed no significant difference ($F = 2.04$,1,125, $p<.25$).

Subjects were also asked to rate, on a seven-point scale, how much they would like to have the lecturer as a teacher in a real classroom situation. Once again, the only significant effect was due to the treatment condition ($F = 8.06$,5,124, $p<.001$). Subjects in the Essay condition (mean = 4.00) responded more favorably than did subjects in any of the other conditions ($F = 33.05$,1,125, $p<.01$). No significant differences were found between the Audio mean (2.47) and the average of the four means (1.87) in the Videotape conditions ($F = 3.27$,1,125, $p<.10$), nor between the Constant Gaze mean (2.13) and the No Gaze mean (1.62) ($F = 1.99$,1,125, $p<.25$).

Evaluation of lecture

Subjects evaluated the lecture on three seven-point semantic differential scales (shallow-profound, worthless-valuable, boring-interesting). Each subject's responses to the three scales were combined to produce one score with a potential range from 3 to 21. Mean Lecture Evaluation scores are presented in Table 17. An analysis of variance of these scores revealed a significant interaction between subjects' sex and treatment conditions ($F = 3.87$,5,119, $p<.003$). Generally, the males evaluated the lecture more positively than did the females except when the lecturer looked infrequently.

Table 17

Mean Lecture Evaluation

		Constant Gaze	Infrequent Glances	Frequent Glances	No Gaze	Audio	Essay
Male Subjects	$\bar{x}$	11.75	8.86	13.15	12.27	12.42	12.91
	n	12	14	13	15	12	11
Female Subjects	$\bar{x}$	12.55	13.83	11.00	10.30	10.80	11.25
	n	11	12	11	10	5	4
TOTAL $\bar{x}$		12.13	11.15	12.17	11.48	11.94	12.47

Discussion

The experimental manipulations had no effect upon the degree of attitude change of the subjects. Subjects changed toward more favorable responses regardless of the media used to convey the message or of what the videotaped lecturer did with his eyes. If one does not wish to accept the conclusion that neither the videotaped lecturer's behavior nor the media have a persuasive impact, then there are at least three more explanations of these results. One is that the message was so highly favorable in content that it overrode both the effects of the lecturer's behavior and the effects of the media by which the lecture was presented. According to this explanation, a less favorable message should produce different results.

A second explanation has to do with the demand characteristic of a pre-test, post-test attitude change paradigm. It is known that many subjects wish to be helpful to the experimenter in supporting his hypotheses. Even though precautions were taken, subjects in this experiment could have deduced, upon receiving the post-test, that the experimenter was interested in their indicating a favorable attitude toward Mexican people.

A third explanation involves the impression generated by the lecturer. Considering the evaluation of the lecturer in the Essay, Audio, and Videotape conditions, we find that as the subjects gained more information about the lecturer, they evaluated him less favorabley. Subjects who heard his voice rated him more negatively than those who merely read his words, while those who both heard and saw him were most negative of all. The instructions given the lecturer probably produced this negative evaluation. In order to eliminate the effects of any nonverbal behaviors other than gaze direction, he was told to remain as motionless as possible and to keep a constant facial expressions Thus, the relatively negative impressions produced by the videotaped lecturer could have depressed the attitude change socres of the subjects in the videotaped conditions.

Future experimentation using this paradigm and methodology should provide safeguards against these unwanted variables.

Experiment 4: The Effects of a Videotaped Lecturer's Pattern of Gaze Upon Teaching Effectiveness

This study makes use of a similar procedure and dependent variables as Experiment 1, i.e., the effect of a lecturer's gaze direction upon student's retention of lecture content and evaluation of the lecturer is investigated. More subtle manipulations and greater control of the lecturer's gaze were desired so the lecturer was recorded on videotape.

Different patterns of the lecturer's gaze were created by varying two dimensions, duration and frequency of looking towards the camera. The values used as guidelines for duration and frequency were chosen on the basis of pilot work done in classrooms.

Method

Subjects

Fifty-six female undergraduates at the University of South Dakota participated in the experiment.

Design

A 2 x 2 factorial design was employed with two levels of the lecturer's gaze duration (Short, Long) and two levels of the lecturer's gaze frequency (Infrequent, Frequent). Dependent variables included the degree of subjects' retention of the lecturer's message (quiz scores) and the subjects' perception of the lecturer (semantic differential scores).

Procedure

Fourteen students in each experimental condition viewed a videotape of a male lecturer. Three to six students viewed the tape at any one time. After the students had been seated before the TV monitor, the female experimenter gave the following instructions:

> The purpose of this experiment is to investigate the influence of certain variables

in the videotape presentation of a lecture. There are several different tapes of the same material and lecturer. You will see one of the tapes. Then you will rate the presentation and take a multiple choice test over the information in the tape.

Later, to evaluate the effects of the different tapes, we will compare your ratings and quiz scores with those of people viewing the other tapes.

Your cooperation is essential to the outcome of the experiment. Please pay close attention to the tape. Please do the best you can on the test and rate the lecturer exactly the way you feel.

The tape presentation will last less than 7 minutes. Then you will have approximately 15 minutes to answer the quiz and questionnaire. Do not put your name on either one. Do you have any questions?

The students then viewed a videotape of a male speaker who presented information about the Schlieffen plan, a German military plan for World War I (see Appendix A-1). After viewing the 6 1/2 minute tape, the students rated the lecturer on 9 semantic differential scales (effective-ineffective, vibrant-still, static-dynamic, unpersuasive-persuasive, unresponsive-responsive, inattentive-attentive, boring-exciting, profound-superficial, simple-complex).

Finally, the students completed a 20-item multiple-choice test (Appendix A-7) on the lecture. An initial version of the test had been given to a different group of 53 students after they had viewed one of the videotapes. Overly difficult items had been eliminated or reworded as necessary.

The videotapes were created two at a time by using two videotape units. The cameras were positioned 3 feet apart. The lecturer sat on a chair with his head oriented straight forward. At appropriate times he moved his eyes to one or the other camera.

To create the tapes with looks of high frequency, long total duration (HF, LD) and high frequency, short total duration (HF, SD), the lecturer addressed sentences to one camera and a phrase or word to the other camera. Tapes with looks of low frequency, long total duration (LF, LD) and low frequency, short total duration (LF, SD) were created by having the lecturer address whole paragraphs to one camera and individual sentences to the other camera. For all four tapes, the lecturer occasionally looked at his notes.

After repeated filming attempts, the final four versions selected had the following specifications:

	# Glances	Total gaze duration	Total film duration	Looked down at notes
1. HF,LD	43	4'37"	6'20"	20"
2. HF,SD	42	1'23"	6'20"	20"
3. LF,LD	15	4'25"	5' 5"	20"
4. LF,SD	14	1'20"	6' 5"	20"

Results and Discussion

Out of a possible score of 20, subjects' quiz scores ranged from 5 to 18. Mean quiz scores for each of the four experimental conditions are presented in Table 18. An analysis of variance of the quiz scores revealed no acceptably significant main effects or interactions. The apparent Duration main effect was significant at less than the .25 level ($F = 2.69$, $df = 1,52$).

Responses to the nine semantic differential scales used to rate the lecturer were intercorrelated and, as expected, fell into two categories. The scales in one category, that related to the lecturer's persuasiveness (effective, vibrant, dynamic, persuasive, responsive, attentive, exciting), were combined to produce a Persuasiveness score for each subject.

The scales in the second category (profound, complex) had to do with the lecturer's profundity. These two scales correlated .40 with each other and had only low-order correlations with the seven Persuasiveness scales. Therefore the two scales were combined to produce Profundity scores.

Analyses of variance of Persuasiveness scores and of Profundity scores revealed no significant main effects or interactions. The videotaped lecturer's pattern of gaze had no effect on the viewer's perception of him. Generally, the viewers rated him as not very persuasive (overall mean = 2.21) and not very profound (overall mean = 3.54).

The results of this experiment and those of Experiment 3 provide consistent evidence that a videotaped lecturer's gaze pattern makes little difference in his actual and perceived persuasiveness. It must be kept in mind, however, that this statement is based upon data obtained from one particular lecturer. The absence of an effect may be due to his individual peculiarities.

Table 18

Mean Quiz Scores

		Gaze Duration		
		Long	Short	
Gaze Frequency	High	9.93	11.57	10.75
	Low	9.50	10.86	10.18
		9.72	11.22	

Conclusions and Recommendations

The results of this project indicate that a lecturer's direction of gaze can influence his audience's retention of the lecture content and their perception of him. It appears that certain variables may serve to enhance or diminish the effects of the lecturer's gaze. If the lecture content is quite interesting, the audience may retain much of the lecture regardless of the direction of the lecturer's gaze. He might even look down constantly at his notes. The audience's attention in a less interesting lecture, however, might be helped along by the lecturer's search for eye contact with audience members. The combination of an uninteresting lecture delivered by a non-looking lecturer could prove disastrous in terms of audience retention of lecture content.

The amount of looking (both frequency and duration) by the lecturer can also influence his effectiveness. A certain amount or level of search for eye contact on the part of a lecturer appears to be expected by the audience. Very little or no eye contact may result in the audience negatively evaluating the lecturer and paying little attention to his lecture. A high degree of eye contact with particular members of the audience may result in their being more attentive to the relationship between the lecturer and themselves than to the lecture.

There is nothing mystical about the effects of a lecturer's gaze upon his audience, such as the beaming of thought waves from one brain to another after making eye contact. As indicated above, the concepts of attentiveness and interest adequately explain the effects of gaze. A lecturer who looks occasionally into audience members' eyes shows that he is interested in the audience and is monitoring their reactions. His attentiveness is returned by the audience.

It appears that gaze-direction loses its effectiveness as an attention-getter in videotaped lectures. This may be due to decreased "demand characteristics" in the videotape situation. The "live" gazing lecturer may be perceived by the subject as constantly monitoring his

degree of attention. Social pressures are such that the subject feels compelled to at least act as if he is paying attention. Subjects viewing a videotape, however, know that the gazing lecturer is neither showing interest in the audience nor monitoring their reactions. Consequently, these subjects feel little pressure to return the lecturer's gaze. The effectiveness of a videotaped lecturer may depend more upon such nonverbal behaviors as voice tone and facial expression rather than direction of gaze.

Next steps in this line of research involve experimentation in both the laboratory and in actual classrooms. It is necessary to make use of the more controlled atmosphere of the laboratory to effectively gauge the interrelation of such variables as the lecturer's nonverbal behavior, the interest value of the lecture, sex and size of audience, and the physical setting of the classroom, as well as the effect of these variables upon student evaluation of the lecturer and student retention of the lecture content.

It is equally necessary to get out of the lab and take a look at what is happening in the actual classroom. The nonverbal behavior of lecturers who are perceived as effective or ineffective teachers by their students needs to be explored. From the results of Experiments 1 and 2, it might be predicted that the effectiveness of a lecturer in a small classroom depends upon an interaction between his degree of gaze at the audience and the interest value of the lecture content.

The nonverbal behavior of members of the audience is also worthy of investigation. Not only can their behavior serve as an indicator of their attention level, but it can also affect the lecturer's behavior. Techniques for observing and recording audience behavior are currently being experimented with by the author in his own classrooms.

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Appendix A-1
Lecture for Experiments 1, 2, & 4

I would like to talk about a plan which changed the subsequent course of world history. The plan, the Schlieffen plan, was the German military plan for World War I. Interestingly enough, though the plan was brilliantly and boldly conceived, it failed. Had it succeeded, the world today would be drastically different, and it probably would be better off.

As a result of the political and military alliances in Europe prior to World War I, it was inevitable that in any war in which Germany engaged, she would have to fight on two fronts; against France in the West, and against Russia, France's ally, in the east. Germany wanted to avoid a two-front war at any cost, and the Schlieffen plan was designed to achieve this objective.

The Schlieffen plan was conceived by the Chief of the German General Staff, Alfred von Schlieffen. According to the plan, to avoid a two-front war it was necessary to attack the strongest, most powerful and dangerous enemy first--and that was France. The plan allocated 7/8's of German's forces, but only 6 weeks, to smash France; while 1/8 of her force was allocated to defend her eastern frontier against Russia, until the bulk of the army, after defeating France, could be transferred to attack Russia. The Germans gambled that France would be defeated before Russia could mobilize and attack, thus avoiding a two-front war.

To understand the Schlieffen plan, it is necessary to understand a little of European geography. France and Germany share a common border for several hundred miles. However, in the north, the two countries are separated by the neutral country of Belgium. The western part of northern France borders the English channel. In the east, Russia shared an extensive common boundary with Germany.

There were two possible German military strategies of attack against France, frontal or envelopment. A frontal attack across the common border was precluded by a chain of French fortresses along the border. The only way to defeat France quickly was to outflank or envelop her Armies, which would then allow Germany to attack

and destroy French forces from the rear. (The strategy of envelopment is kind of an endrun around the flanks that allows the attacking force to destroy the enveloped force from the rear where it is particularly vulnerable.) However, to achieve envelopment of French forces meant that Germany would have to advance through Belgium and violate that country's neutrality.

The German forces in the west were divided into two wings. Most of the forces were heavily concentrated in the right or northern wing which would advance into France through Belgium. In order to envelop the French army, the right wing was to reach almost as far west as the English Channel. Schlieffen's famous command was, "When you march into France, let the last man on the right brush the Channel with his sleeve." From there, they would sweep down the plains, behind the French forces, toward Paris. The left or southern wing contained far fewer forces and was responsible for defending Germany against the French attack.

This, in essence, was the Schlieffen plan. The Germans allowed a rigidly scheduled six weeks to achieve its objectives. Military-wise, it was bold and brilliant. However, it did contain some erroneous assumptions. It was assumed that violation of Belgium's neutrality would not produce too much of an adverse world reaction, that Belgium would not fight, and that Russia could not attack Germany until France was defeated. These assumptions were incorrect. In addition, there were several critical errors in the execution of the plan.

The outbreak of the war was precipitated when Serbian nationalists assassinated the heir to the Austrian throne, Archduke Franz Ferdinand. This event let loose an irresistible onrush of events. Austria, assured of support by her ally, Germany, attacked Serbia. Russia began to mobilize to honor her commitment to defend Serbia. Germany mobilized immediately to attack France, and on the basis of a flimsy pretext, German forces advanced into Belgium on August 4, 1914. Contrary to German expectations, the Belgians decided to fight, and the first battle of the war took place at Liege, Belgium. The French response was an immediate attack on Germany.

The Belgian forces and defense were no match for the much larger and better equipped German forces. The German army was well prepared to fight the first modern war. It was well equipped with modern weapons and transportation; the battle plans were thoroughly prepared, and the troops were well-trained. German might and superiority eventually overwhelmed the Belgian defense, but not before they had put up a courageous fight that both captured the sentiments of the world, and more importantly, delayed the German advance. This delay was to prove costly to the Germans.

During the Belgian campaign, the Germans made a critical mistake by conducting a campaign of terror which thought would shorten the war. Burning, pillaging and massacres took place throughout Belgium. This terror campaign plus the naked violation of Belgium's neutrality were responsible for turning world opinion against Germany, and resulted in the entrance of Britain, and eventually America, into the war against Germany and ultimate German defeat. If any one event during this campaign of terror was responsible for the turning of world opinion, it was the burning and sacking of Louvain. Louvain, a medieval city founded in 1426, was renowned for its university and incomparable library which contained irreplaceable books, manuscripts and other items. The Germans destroyed the city, including the university and the library. The burning, looting and shooting in Louvain was reported to the world by the neutral press, and was very instrumental in solidifying world opinion against Germany--from then on, the Germans were pictured as cruel, brutal barbarians.

Though the Belgian resistance delayed the German advance and upset their timetable, German forces soon swept into Northern France. Initially, the invasion of France was quite successful. This was due both to the excellence of the German war machine and to several French mistakes. First of all, the French forces were concentrated along the common border from where the French launched their attack on Germany through the regions of Alsace-Lorraine. They expected to break into Germany, before the Germans could advance too far, and thus force the Germans to withdraw to defend their homeland. However, they were not successful in breaking through German lines, and of course the Germans were

advancing quickly enough so that they were soon threatening Paris and the Rear of the French forces. In addition to this failure, the French army was not prepared to fight a modern war. They still relied on Cavalry units, the infantry employed outdated techniques, and the soldiers were clad in bright red and blue uniforms which made them distinctive targets.

Before the French could mount an effective defense, the Germans had advanced almost to Paris. At this point, the French, with the help of a small British force, prepared to launch a do-or-die defense which would either stop the Germans or constitute France's last significant battle in the war. It was at this point that the Germans made two critical errors which reduced their chances of victory and aided the French.

I have been ignoring the war in the East, but it did have a significant effect on the German offensive in France. Russia was able to mobilize and attack faster than Germany had anticipated, and she achieved some early victories. When the Russians made their initial advances, however, the German High Command panicked and withdrew two divisions from the west, transferring them to the Russian front. This was the first critical error. As it turned out, the Russian offensive was a one-shot effort which was soon exhausted, and they were decisively and disasterously defeated by the regrouped German forces, without the benefit of the two transferred divisions which were still enroute. So the two divisions were unnecessary in the East, while they were needed in the West.

In addition to the withdrawal of the two divisions, the German High Command made a second error in departing from the Schlieffen plan. The western wing of the advancing Germans, rather than continuing their advance towards Paris, turned inward and advanced east toward the Marne, which allowed the French the opportunity to attack the Germans' exposed and vulnerable flank. If the German forces had continued toward Paris as planned, and if they had not depleted their strength by 2 divisions, it is likely that the Germans could have overcome the French defense and achieved victory.

At the Marne, the regrouped French and British forces with additional French troops from the Franco-German border were finally able to achieve numerical superiority. They met the German advance and the Miracle of the Marne occurred. The Allied victory at the Battle of the Marne stopped and broke the back of the German offensive and resulted in a German retreat. The Germans lost their bid for decisive victory and thereby their opportunity to win the war. Unfortunately, for France, for the Allies, and in the long run for the world, the Miracle of the Marne fell short of the victory it might have been. The war in the west settled down into a long and costly stalemate--it became a war of trenches and attrition. The Schlieffen plan had failed, and so had its French counterpart, Plan 17. As a result, the future course of world history was changed.

Of course, the Germans were eventually defeated as a result of the Allied offensive which began in 1917. However, despite the Allied triumph it was a hollow victory. The deadlock which was determined by the failures of the Schlieffen Plan and Plan 17 in turn predetermined that the war would be long and costly for everyone. It sucked up lives, materials and resources, energy, money and brains in fantastic quantities. The course of the war determined the peace terms, the shape of the interwar period, and the conditions of World War II. For example, the war produced conditions in Russia which aided the Communists immensely in their rise to power. It is doubtful whether the Communists could have achieved power without the conditions imposed by the lengthy and costly war. The devastation in Europe and the harsh peace conditions imposed on Germany produced conditions which made it possible for Hitler to rise to power. It is ironic that the tragedy and consequences of one world war should determine a tragic second world war.

Appendix A-2

Rating Scale

Please do not sign your name. You will remain anonymous.

This study is part of a program designed to improve teaching ability. Your task now is to rate the speaker whom you have just heard. It is crucial to the success of the program that your ratings accurately reflect your feelings. Please be honest. The speaker will NOT see your ratings.

Please describe the speaker on the scales listed below. Place a checkmark in a position which best represents your feelings. Please do not omit any scale.

Make each item a separate and independent judgement. Work as rapidly as possible.

Passive:____:____:____:____:____:____:____:Active

Inattentive:____:____:____:____:____:____:____:Attentive

Unfair:____:____:____:____:____:____:____:Fair

Good:____:____:____:____:____:____:____:Bad

Sad:____:____:____:____:____:____:____:Happy

Fast:____:____:____:____:____:____:____:Slow

Valuable:____:____:____:____:____:____:____:Worthless

Sweet:____:____:____:____:____:____:____:Sour

Dishonest:____:____:____:____:____:____:____:Honest

Clean:____:____:____:____:____:____:____:Dirty

Intimate:____:____:____:____:____:____:____:Remote

Unsure:____:____:____:____:____:____:____:Confident

Remember to make each item a separate and independent judgement. Work as rapidly as possible.

*Nice:____:____:____:____:____:____:____:Awful

*Secretive:____:____:____:____:____:____:____:Frank

*Pleasant:____:____:____:____:____:____:____:Unplesant

*Cruel:____:____:____:____:____:____:____:Kind

Superficial:____:____:____:____:____:____:____:Profound

Calm:____:____:____:____:____:____:____:Agitated

*Loud:____:____:____:____:____:____:____:Soft

*Deep:____:____:____:____:____:____:____:Shallow

Ferocious:____:____:____:____:____:____:____:Peaceful

Tense:____:____:____:____:____:____:____:Relaxed

*Brave:____:____:____:____:____:____:____:Cowardly

Hazy:____:____:____:____:____:____:____:Clear

Stale:____:____:____:____:____:____:____:Fresh

Rugged:____:____:____:____:____:____:____:Delicate

Illogical:____:____:____:____:____:____:____:Logical

Dynamic:____:____:____:____:____:____:____:Static

Obvious:____:____:____:____:____:____:____:Subtle

Ordered:____:____:____:____:____:____:____:Chaotic

Competent:____:____:____:____:____:____:____:Incompetent

Complex:____:____:____:____:____:____:____:Simple

Unpersuasive:____:____:____:____:____:____:____:Persuasive

Remember to make each item a separate and independent judgement. Work as rapidly as possible.

Varied:____:____:____:____:____:____:____:Repetitive

Rational:____:____:____:____:____:____:____:Emotional

Vibrant:____:____:____:____:____:____:____:Still

Vague:____:____:____:____:____:____:____:Precise

Sincere:____:____:____:____:____:____:____:Insincere

Controlled:____:____:____:____:____:____:____:Loose

Convincing:____:____:____:____:____:____:____:Unconvincing

Boring:____:____:____:____:____:____:____:Exciting

Friendly:____:____:____:____:____:____:____:Unfriendly

Unaware:____:____:____:____:____:____:____:Aware

Responsive:____:____:____:____:____:____:____:Unresponsive

Ineffective:____:____:____:____:____:____:____:Effective

*Direct:____:____:____:____:____:____:____:Evasive

How much would you like to have this person as a teacher in a real classroom situation?

Dislike:____:____:____:____:____:____:____:Like

Please give your opinion as to how the speaker's performance could be improved by placing a checkmark in the appropriate column.

	YES	NO
Should speak louder		
Should speak more distinctly		
Should speak slower		
Should speak faster		
Should make more gestures		
Should make fewer gestures		
Should improve personal appearance		
Should look in eyes more		
Should look in eyes less		
Should simplify lecture		

Can you think of anything more the speaker could do to improve his performance? If so, what?

Please rate the lecture you heard, not the speaker, on the following scales.

Interesting:____:____:____:____:____:____:____:Boring

Valuable:____:____:____:____:____:____:____:Worthless

False:____:____:____:____:____:____:____:True

Profound:____:____:____:____:____:____:____:Shallow

Any comments you have concerning any aspect of the experiment will be appreciated. Please make your comments in the space below.

*Note.-- Due to the limited capacity of the computer in the number of variables it could handle in a factor analysis, eleven scales which upon initial inspection either gave redundant information or seemed meaningless to the subjects were omitted from the analysis.

Appendix A-3
Quiz for Experiments 1 and 2

Below are questions concerning the lecture you just heard. Please answer them as best you can. Answer in one word or a brief phrase. If you cannot recall an answer, simply go on to the next question.

All that is asked is that you do the BEST YOU CAN.

Please do not sign your name. You will remain anonymous.

1. Where did the first battle of World War I take place?

2. What was the responsibility of the left-wing of the German forces?

3. The burning and sacking of what city and its renowned university and excellent library was most responsible for turning world opinion against Germany?

4. Who was Germany's principal ally?

5. What event precipitated or set off World War I?

6. What two things involving Belgium turned world opinion against Germany?

7. The Germans were especially careful to avoid what kind of war?

8. What is the name for the military technique or strategy that Germany used to attack France?

9. What was the name for the German military plan for World War I, particularly in regards to the invasion of France?

10. The war and its consequences contributed to the rise to power of what individual and what group?

11. What was the French counterpart to Germany's military plan for war?

12. In what specific way did the war in the East (Russia vs. Germany) reduce the chances of German victory in France?

13. What critical battle did France and her allies win which broke the back of the German offensive?

14. What critical mistake did the Germans make which resulted in the halt of their advance near Paris and reduced their chances of victory?

15. Name one way in which the French forces were not prepared to fight a modern war?

16. How familiar were you with the content of the lecture before you heard it today?

Very Familiar:	____	____	____	____	____	____	____ :Not At All Familiar

Appendix A-4

Frequency/Duration in Seconds of Lecturer's Gaze
at Individual Subjects

Lecture

	G*	S1	S2	S3	S4
Gaze	1	60/80.8	60/59.8	61/58.4	46/60.8
	2	40/83.2	50/64.2	50/62.2	39/53.8
	3	27/44.6	36/40.8	48/51.8	34/50.4
Preferred Gaze	1	---	82/141.4	---	72/121.4
	2	87/127.8	92/118.8	---	
	3			105/186.4	58/109.8
	4	---	69/104.2	78/103.8	
	5	79/150.6			70/100.6
	6	84/169.0	---	67/130.4	---

Seminar

	G*	S1	S2	S3	S4
Gaze	1	42/82.8	54/91.2	53/75.4	35/66.8
	2	39/79.4	58/86.0	58/71.8	44/74.4
	3	49/96.4	64/82.4	54/91.0	33/71.0
Preferred Gaze	1	---	---	123/153.6	102/126.0
	2	---	78/179.6	70/165.8	---
	3	69/179.0	---	---	53/152.0
	4	72/114.8	---	85/107.6	---
	5	77/122.6	92/124.6	---	---
	6	---	71/141.0	---	69/129.2

*Note

G = Group

S = Subject within that group

Appendix A-5

Individual Quiz Scores According to Experimental Condition

Lecture

	G*	S1	S2	S3	S4
Gaze	1	7.5	3.5	11.5	8.5
	2	2.5	10.0	11.5	2.5
	3	3.5	5.0	1.5	8.5
No Gaze	1	0.0	9.5	2.5	1.0
	2	2.5	1.0	4.0	2.5
	3	7.0	8.0	2.0	6.5
Preferred (Excluded) Gaze	1	3.0	(4.0)	(4.5)	0.0
	2	(3.5)	0.0	3.5	(2.5)
	3	6.5	(6.0)	7.0	(11.0)
	4	(6.5)	3.5	(3.0)	1.0
	5	5.0	2.0	(4.0)	(0.0)
	6	(3.5)	(2.0)	1.0	2.0

Seminar

	G*	S1	S2	S3	S4
Gaze	1	10.5	3.0	7.5	10.0
	2	5.5	3.5	8.5	12.5
	3	8.0	1.0	1.5	8.0
No Gaze	1	3.0	10.5	2.5	8.0
	2	1.0	2.0	3.0	6.5
	3	0.5	7.5	2.0	5.5
Preferred (Excluded) Gaze	1	(0.0)	(3.0)	7.5	1.5
	2	1.5	(9.0)	10.0	(3.5)
	3	9.0	8.0	(2.0)	(2.5)
	4	(1.0)	7.0	(3.5)	1.0
	5	(7.5)	1.5	1.0	(0.5)
	6	7.0	(1.5)	(8.0)	12.5

*Note G = Group - S = Subject within that group

Appendix A-6

Frequency of Suggestions for Improvement of Lecturer's Performance

	Gaze	Preferred Gaze	Excluded Gaze	No Gaze
Speak louder	4	4	2	5
Speak more distinctly	23	24	23	22
Speak slower	24	21	23	22
Speak faster	0	0	0	0
More gestures	23	23	24	24
Fewer gestures	0	0	0	0
Improve appearance	5	4	1	5
Look more	3	4	18	23
Look less	0	5	1	0
Simplify lectures	8	18	15	19

Appendix A-7

Quiz: THE SCHLIEFFEN PLAN

Select the best alternative and mark your choice on the answer sheet. Please make no marks on the test.

1. The Schlieffen Plan was designed to do all of the following except:
   a) win the war for Germany
   b) avoid a simultaneous two-front war
   c) keep Britain out of the war
   d) attack France through her strength
   e) avoid trench warfare in the west

2. The Plan allowed ____ month(s) for the defeat of France.
   a) 1
   b) 1½
   c) 2
   d) 4
   e) 6

3. The first battle of the war took place at
   a) Liege
   b) Louvain
   c) the Franco-German border
   d) the Marne
   e) the Russian border

4. The Germans first entered France:
   a) at the Franco-Belgian border
   b) at the Franco-German border
   c) from the English channel
   d) along the Marne
   e) through the Maginot Line

5. "Guns of August" might be about:
   a) the Miracle at the Marne
   b) the Battle of the Bulge
   c) the Allied offensive of 1917
   d) trench warfare
   e) the Belgian defensive of 1914

6. The "Miracle at the Marne" was a miracle because:
   a) French and British troops, despite numerical inferiority, defeated German troops
   b) the German advance was stopped
   c) the Allies began the offensive that eventually ended the war
   d) it saved Paris from German troops
   e) the Marne was a difficult place to achieve a victory

7. The Schlieffen Plan's mistakes in political strategy did not include assuming that:
   a) world opinion would not be influenced by violating Belgian neutrality
   b) the "rape of Belgium" would shorten the war
   c) Belgian forces would surrender without fighting
   d) the Belgian defensive would be ineffective in halting German advance
   e) Russian mobilization could occur before the defeat of France

8. The Belgian resistance led to:
   a) delay of the German timetable
   b) defeat of the advancing Germans
   c) bad press for Belgium
   d) good press for Germany
   e) altering the direction of German attack in France

9. Why did the Schlieffen Plan fail?
   a) the German High Command followed it too rigidly
   b) Russia was defeated before France
   c) in France the Germans were short two divisions and altered the direction of attack
   d) the French plan for victory, Plan 17, succeeded
   e) it did not take into account trench warfare

10. All of the following were true of Louvain except:
   a) it had a famous university and library
   b) it was part of the "rape of Belgium"
   c) neutral press reported its destroyal
   d) world reaction was strong against the German burning and sacking there
   e) it provoked the German attack

11. The two German divisions sent east to Russia
    a) were needed for Russian defeat
    b) were needed for French defeat
    c) arrived in time to help the German forces in Russia
    d) kept the High Command from panicking about early Russian victories
    e) did not influence the success of the Schlieffen Plan

12. Which of the following is <u>not</u> true about the Schlieffen Plan:
    a) Germany drew it up
    b) the time was World War I
    c) it was a failure
    d) the military strategy was brilliant
    e) it involved simultaneous fighting on two fronts

13. According to the Schlieffen Plan
    a) France was to be defeated first
    b) the German forces would be divided equally between the French and Russian fronts
    c) France was to be defeated in 6 months
    d) Russia would be able to mobilize quickly and win early victories
    e) Russia was the more dangerous enemy

14. Frontal attack on France would <u>not</u> have involved
    a) violation of Belgian neutrality
    b) overcoming heavy French fortifications
    c) more time and greater manpower loss
    d) meeting French expectations about the locus of attack
    e) division of the war into two fighting fronts

15. An assumption of the plan was:
    a) strongly unfavorable reaction to violating Belgium's neutrality
    b) Belgians would not resist the German advance
    c) Russian mobilization would lead to early Russian victories
    d) France was more powerful and dangerous than Russia
    e) successful envelopment would lead to quicker victory

16. Germany first attacked:
    a) Serbia
    b) Belgium
    c) France
    d) Russia
    e) Britian

17. The Belgian resistance did not
    a) temporarily withstand the German attack
    b) delay the execution of the Schlieffen Plan
    c) arouse world interest
    d) face well-equipped German soldiers
    e) save Louvain's manuscripts

18. The German High Command thought all of these would lead to quick victory in the war except
    a) adherence to the Schlieffen Plan
    b) violating Belgian neutrality
    c) conducting a terror campaign in Belgium
    d) defeating Russia before France
    e) superiority of the German war machine

19. World opinion about Germany changed particularly after reports about the
    a) attack on Liege
    b) destroyal of Louvain
    c) advance against Paris
    d) laying waste to the French countryside
    e) Miracle of the Marne

20. Initial French defeats were due to all these except
    a) concentration of French troops at the fortified border
    b) abortive French attacks on Germany
    c) interior French equipment
    d) quick movement of the advancing Germans
    e) additional German forces to defend their homeland